A Review of Interventions to Reduce Tobacco Use in Colleges and Universities

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Background: Interventions have been designed to reduce the prevalence of smoking in college/university students. This review presents a summary and synthesis of the interventions published in English from 1980 to the present.

Methods: Seven databases were searched for relevant published articles, and reference lists were examined for additional published studies. The studies were categorized as (1) individual approaches, such as on-campus cessation programs, and (2) institutional approaches, such as smoke-free policies. The studies were categorized by type of institution and geographic location, study design, sample demographics, and outcomes.

Results: Fourteen studies were identified; only five received a "satisfactory" rating based on evaluation criteria. Most studies were based on convenience samples, and were conducted in 4-year institutions. Seven studies used comparison groups, and three were multi-institutional. Individual approaches included educational group sessions and/or individual counseling that were conducted on campus mostly by healthcare personnel. None used nicotine replacement or other medications for cessation. The quit rates for both smokeless tobacco and cigarette users varied, depending on definitions and duration of follow-up contact. Institutional interventions focused mainly on campus smoking restrictions, smoke-free policies, antitobacco messages, and cigarette pricing. Results indicated that interventions can have a positive influence on student behavior, specifically by reducing tobacco use (i.e., prevalence of cigarette smoking and use of smokeless products, amount smoked) among college students, and increasing acceptability of smoking policies and campus restrictions among both tobacco users and nonusers.

Conclusions: While some promising results have been noted, rigorous evaluations of a wider range of programs are needed, along with studies that address cultural and ethnic diversity on campuses.

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Introduction

Evidence from recent large surveys of college students (aged 18 to 22) indicates that this population is taking up smoking at an alarming rate.[1,2] For example, in a nationwide survey of 4-year college students in 1997, Wechsler et al.[1] found that 22.3% reported current smoking, and Rigotti et al.[2] in 1999 found that 32.9% reported current smoking. Earlier, a 1995 nationwide survey found that 29% of the college students reported current cigarette use[3] (with current smoking being defined as at least one cigarette in the past 30 days), and nearly three fourths of college students (74.8%) reported having ever tried cigarettes smoking.[4] From 1992–1993 to 1999–2000, the prevalence of current smoking (with current smoking being defined as smoking every day or some days) increased among people aged 20–24 years with ≥13 years of education, from 17.9% to 22.7%. College students are also experimenting with various other tobacco products such as smokeless tobacco[5] and cigars.[6] In 2000, 5.5% of males aged 18 to 24 reported currently using chewing tobacco or snuff,[7] and 5.5% reported currently using cigars.[7] In the second half of the 1990s, while smoking declined among secondary school students,[8] smoking prevalence increased significantly for college students.[9] The reason for the increase among young adults is unclear, and may reflect (1) a "cohort effect," as an earlier group of high school smokers moved into older age groups, (2) an actual increase due to a tobacco industry shift in marketing to this group, or (3) a combination of both factors. Since the 1960s, smokers aged <25 have been a major marketing target, and are considered to be critical for the long-term

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Table 1. Distribution of characteristics by type of intervention

Type of intervention	Number of articles	Type of tobacco use		Type of funding			Type of institution		
		Smokeless	Smoked	Private	Public	Not specified	4-year	2-year	Not specified
Individual only	9	1	7	2	5	1	8	0	1
Institutional only	4	1	4	3	1	1	4	0	0
Individual and institutional	1	1	0	1	0		1	0	0
Total	14	3	11	6	6	2	13	0	1

performance and profitability of the tobacco industry.[10,11] But after the 1998 Master Settlement Agreement,[12] tobacco companies appear to have further increased their marketing to young adults aged 18 to 24, with reviews of industry documents demonstrating this targeting.[13] Promotions in bars and clubs,[13] advertising in college newspapers, free samples to college newspapers and to college students,[12] developing appealing packaging and imagery for specific brands,[14] and price-related promotions[15] have all been used.

Colleges and universities offer potential sites for tobacco-reduction interventions and can play a useful role in promoting prevention and cessation.[16] In 1999–2000, more than 14.5 million students were enrolled in the nation's 4182 colleges and universities.[17] Using a current prevalence figure of 30%, this translates into 4.35 million college and university students who are currently smoking. The purposes of this review are to (1) provide a comprehensive summary of individual and policy interventions that have been implemented, evaluated, and peer reviewed since 1980; (2) synthesize the findings from these studies; and (3) make recommendations for future programs and research.

Methods

Searches were carried out for articles published in English since 1980 that evaluated policies and programs designed to reduce tobacco use on college campuses and to provide cessation services for students. Databases searched included the one maintained by the Office on Smoking and Health (1980–December 2003), MEDLINE (1980–December 2003), PsychINFO (1980–December 2003), Current Contents/Social and Behavioral Science (1999–December 2003), Current Contents/Clinical Medicine (1999–December 2003), Current Contents/Life Sciences (1999–December 2003), ERIC (1980–December 2003), and EMBASE (1980–December 2003).

Key words in the search included "college students," "university students," and "young adults" in combination with "smoking cessation," "quitting," "intervention," "restrictions," "policy," "smokeless tobacco," "smoking," "tobacco," "behavior," "perception," and "attitude."

Ninety-eight articles were initially identified and their references were further reviewed to obtain additional articles not cited in the databases. The 14 studies included in this review met the following criteria: peer reviewed, empirical evaluation of an intervention, and based at a college/university irrespective of type or location. An additional 20 studies that assessed student perceptions regarding programmatic issues (e.g., quitting process, cessation programs, and policies) were also identified, and are included in the discussion to indicate some of the needs of college students and to make programmatic recommendations.

Information from the articles was tabulated as studies evaluating (1) individual-level interventions, such as on-campus cessation programs, and (2) institutional-level interventions, such as smoke-free policies, smoking restrictions, and antitobacco messages/advertisements. One study that addressed the effect of state-level pricing and restrictions on smoking in public places on college student smoking[18] was included under this second category. One study that evaluated a combination of individual- and institutional-level intervention was listed under both categories.[19] (See tables for summaries.) Studies were also evaluated as to the rigorousness of the evaluation. The *Guide to Community Preventive Services* of 2001 (the Community Guide), was used as a point of reference for a system for rating the suitability of study designs and outcomes.

The following categories were included: (1) study design, (2) definition and selection of study and comparison groups, (3) definition of the intervention and exposure, (4) assessment of outcomes, (5) follow-up and completion rates, (6) bias, (7) data analysis, and (8) examination of confounders. (A copy of the rating criteria is available on request.) Studies were rated as outstanding (met seven to eight criteria), satisfactory (met four to six criteria), or unacceptable (met three or fewer criteria). Studies with ≤25 participants or those that did not include comparison groups were not rated. Two of the authors (RM-H, LLP) rated the interventions independently, and then met to discuss the ratings of each intervention. There was 100% agreement on the overall ratings, with some minor divergence noted on certain subcategories. Ratings for the six studies meeting the inclusion criteria are reported in subsequent tables.

Results

Study Characteristics

Characteristics of schools and interventions are shown in Table 1. Of the 14 studies identified, nine interventions were at the individual level,[20–28] four at the institutional level,[18,29,30,33] and one at both levels.[19] Twelve of the 14 articles were published during the 1990–2001 period, with only two in the 1980s.[20,21] Twelve studies were conducted in the United States,[18,19,20–28,33] mostly in the Midwestern and Eastern states, two (institutional level) were based in Ger-

many,[29] and one in Switzerland.[30] Eleven studies focused on interventions for cigarette smokers, with three addressing reduction of smokeless tobacco use.[19,27,28]

No studies were assessed as outstanding in regard to quality. Of the nine individual-level intervention studies, four were judged as satisfactory, one as unacceptable, and four were not rated due to small sample size or lack of a comparison group. Of the four institutional-level studies, one was rated as satisfactory, and three were not rated. The single intervention study that occurred at both the individual and institutional levels was not rated.

Individual-Level Interventions: Tobacco Smoking

Seven studies evaluated the effectiveness of on-campus individual interventions for smokers. Of these, four[20,21,23,26] used comparison groups, while the remaining three[22,24,25] did not (Table 2).

Most interventions were based on sample sizes of <100 smokers (four studies were conducted with <25 participants).[22–25] With one exception in which both smokers and nonsmokers were exposed to the intervention,[20] all interventions targeted cessation rather than prevention. Participants included volunteers who wanted to quit smoking, students in classes, or individuals who were attending health clinics. Many of the studies used multicomponent interventions, including educational group and didactic sessions, distribution of self-help materials, and individual counseling on campus by healthcare personnel (e.g., physicians, nurses). One intervention incorporated a strategy that used computer-assisted cessation education.[26] In two studies, gradual reduction of amount smoked was targeted by using a strategy that encouraged delay of cigarette smoking[22] and scheduled smoking reduction.[24] One study explored the use of nicotine gum as a substitute for cigarettes for withdrawal symptoms when students were abstinent for a short time,[23] but not as a part of a regular tobacco-cessation program. None of the other studies used recommended pharmacotherapies, such as nicotine replacement or bupropion.[33]

The outcome measures were self-reported abstinence from cigarettes, reduction in the number of cigarettes smoked, or changes in student attitudes toward tobacco use from pre- to post-intervention. Only one study[27] used biochemical validation of self-reported status, and one used a bogus pipeline technique.[28] Duration of follow-up tended to be relatively short (from 3 weeks to 6 months), and the telephone was cited as the means to collect information from participants.

Two studies reported reductions in amount smoked at post-intervention compared to pre-intervention use.[24,25] The amount of the reduction was statistically significant in both studies, but the follow-up period was only 3 weeks, and the sample sizes were small in both studies. Clear definitions of abstinence in terms of duration of nonsmoking were not provided in any of the studies. In studies that used comparison groups and examined cessation,[20,21,26] the abstinence rates tended to be higher in the intervention groups than in the nonintervention groups,[20,21] but none of the differences reached statistical significance. One study reported a quit rate of 33% at 1 year,[22] but it had a small sample (<25). In one of the studies,[21] students who were counseled by physicians felt that the advice was useful but they did not believe that it helped their quitting. At 6 weeks after a computer-assisted intervention,[26] a significantly higher percentage of students exposed to the intervention advanced through the stages of readiness to quit than those exposed to regular health behavior education (48% vs 21%, respectively), but the difference did not persist at 3 and 7 months.

Individual Interventions: Smokeless Tobacco Use

All three studies on individual interventions for smokeless tobacco targeted athletes specifically[19,27,28] (Table 3). The study participants were recruited from varsity baseball and football teams by paper advertisement flyers or by college and athletic department personnel. Sample sizes ranged from 43 to 360. Two of the three studies were multi-institutional,[27,28] and all studies used multicomponent interventions. Williams et al.[27] assessed the effectiveness of a self-help cessation manual combined with individual counseling by coaches and trainers. Walsh et al.[28] and Darmody et al.[19] included oral examination by a dentist or dental hygienist with feedback, behavioral counseling, graphic illustrations of tobacco-related oral lesions, distribution of self-help materials, and follow-up by telephone contact. In two studies,[27,28] outcomes were assessed by self-reported abstinence using pre- and post-test measures, with saliva samples in Williams et al.[27] and the bogus pipeline in Walsh et al.[28]

Both of the studies that examined cessation found that their programs had an impact. In Williams et al.,[27] while the self-reported quit rate at 3 months was 14.5%, there was no difference between those exposed to four sessions (rate of 14.7%) and those exposed to two (rate of 10.6%). In addition, 41% reported decreased tobacco use at 3 weeks and 47.3% at 3 months. Not surprisingly, the successful quitters rated the manual more favorably than nonquitters. In Walsh et al.,[28] which was a multi-institutional randomized study that examined the effectiveness of a smokeless tobacco–cessation intervention for college athletes after 1 year, the cessation percentages were 34.5% at intervention colleges and 15.9% at control colleges ($p = 0.008$). The quit rates were higher in the intervention group (23% at 3 months, 36% at 1 year) than in the control group (15% at 3 months, 16% at 1 year). Sustained abstinence

Table 2. Individual-level intervention: tobacco smoking

Author/ year/ref	Type of institution/ type of students/location	Study design/intervention	Sample demographics	Outcome measures/ follow-up	Findings	Rating
Greenburg (1981)[20]	4-year Public undergraduate students enrolled in public health sciences class New York	Ten classes each assigned randomly to intervention (n=6) and no intervention (n=4); approximately, 30 students per class Intervention: Didactic education based on diffusion of innovation theory, three classes 1 hour each, at 2nd, 6th, and 10th weeks after pre-test. Three classes with emphasis on social approval, academic achievement, and career success	N=342 students from ten classes n=196 (intervention) n=146 (nonintervention) 17% (n=39) smokers Mean age 19.6 years	Factual knowledge about smoking, student motivation to quit, and cognitive and attitudinal statements and self-reported abstinence assessed by pre-tests and post-tests; response rate of 67% (n=228); pre-test, 2nd week of the semester; post-test 14th week of semester	Significant differences in certain items regarding factual knowledge about smoking and attitudes toward smoking cessation in the intervention group; nonsignificant changes in smoker's motivation to attempt cessation and in smoking behavior; quit rate 33% (8/24) in the intervention group and 20% (3/15) in the non-intervention group.	Satisfactory
Hellman (1988)[21]	4-year Students attending health service at a public university New York	Two groups nonrandomly exposed to intervention or no intervention (convenience samples): brief individual counseling by physician with distribution of self-help materials	N=351 smokers n=172 (intervention) n=179 (no intervention) Recruited from students using the student health service	Self-reported abstinence on pre-and post-tests, post-tests available for 75% of students at 1 month, and slightly over half in both groups at 6 months; follow-up at 1 and 6 months by telephone contact	At 1 month, quit rate 12% in the intervention group and 7% in the non-intervention group (p<0.07); at 6 months 10% in the non-intervention group (p<0.2). Students felt that the counseling was useful, but did not believe it helped them quit.	Unacceptable
Rutter (1990)[22]	4-year Students at a public university New Hampshire	Two groups of subjects (convenience samples) were asked to quit by delay technique[a] along with individual counseling by health/ care personnel; terminated at 6 weeks (first group), and at 10 weeks (second group)	N=24 (smokers only) Recruited from students attending smoking-reduction treatment unit	Self-reported abstinence and number of cigarettes smoked; follow-ups at termination and 1 year	Most subjects showed little difficulty in abstaining from cigarettes for 1 day. At 6 to 10 weeks, 4 of 24 students were abstinent (17%), at 1 year, 7 students were abstinent (29%); 17 still smoking at the end of intervention, and of these 8 were using fewer cigarettes at 1 year.	Not rated

Table 2. *(continued)*

Author/ year/ref	Type of institution/ type of students/location	Study design/intervention	Sample demographics	Outcome measures/ follow-up	Findings	Rating
Cohen (1997)[23]	4-year Undergraduate psychology students at a public university Oklahoma	Subjects randomly exposed either to nicotine gum or no gum in a controlled environment where smokers were prevented from smoking for 3 hours	N = 20 (smokers only) with selection criteria. Inclusion: age >18 years using >16 cigarettes/day for at least 6 months; exclusion: quit attempt within last 6 months, those with heart dysfunction/disease, convenience sample	Assessed chewing gum as a substitute for cigarettes; baseline measures and assessment of craving and withdrawal symptoms at time 1 (2 to 2.5 hours) and time 2 (30 minutes later)	Smokers who chewed nicotine gum when access to cigarettes was restricted reported significantly less craving ($p<0.01$) and withdrawal ($p<0.05$) than those who did not have access.	Not rated
Kane (1999)[24]	4-year Undergraduate students at a private college Pennsylvania	All subjects participated in a scheduled smoking treatment approach (both group and individual counseling with advice for scheduled smoking reduction,[b] review of self-help material and-withdrawal symptoms); alternating long and brief sessions for 3 weeks (total 6 sessions)	N=9 smokers who volunteered to participate in smoking cessation program; convenience sample	Self-reported use of cigarettes by maintaining a smoking log. Follow-up at termination of treatment at 3 weeks	Significant reduction in number of cigarettes smoked was found during both the scheduled ($p=0.03$), and reduced/ scheduled days ($p=0.02$) phases of the treatment; abstinence not reported.	Not rated
Kane (1999)[25]	4-year Undergraduate students (young adults and adult) in a private college Pennsylvania	All subjects participated in a home based, model of care smoking cessation program (individual counseling with advice of scheduled smoking reduction plan,[b] review of self-help material, and withdrawal symptoms and relapse prevention); alternating long and brief sessions for 3 weeks (total 6 sessions)	N=13 smokers who volunteered to participate in the program, convenience sample	Self-reported use of cigarettes by maintaining a smoking log. Follow up at termination of treatment at 3 weeks	Reduction in reported number of cigarettes smoked compared to baseline scheduled smoking days ($p=0.007$), reduced/ scheduled days ($p=0.004$); and a significant reduction in cigarettes smoked on reduced/scheduled days compared to scheduled smoking days; abstinence not reported.	Not rated

Table 2. Individual-level intervention: tobacco smoking *(continued)*

Author/ year/ref	Type of institution/ type of students/location	Study design/intervention	Sample demographics	Outcome measures/ follow-up	Findings	Rating
O'Neill (2000)[26]	4-year Undergraduate psychology students at a public university North Dakota	Subjects randomly exposed to either of two computer-administered interventions[c] targeting cigarette smoking based on stages of change model or education on other health behaviors	Through survey distributed to N=1968 students, *n*=65 smokers (67.5% of 96) volunteered for the program. 41 women, 24 men, aged 18 to 25 years, convenience sample	Advancement through stages of change and self-reported abstinence by pre-test and post-test. Follow-ups by telephone contacts at 1, 3, and 7 months with participation rates of 98%, 94%, and 84%, respectively	Significantly higher percentage of advancers in the intervention group (48%) than in the control group (21%) at 6 weeks ($p<0.02$). Slightly higher (nonsignificant) cessation rates in the intervention group than in control groups (19.4% vs 15.2% at 1 month, and 30.0% vs 21.2% at 3 months, respectively); quit rate 30% at 7 months in both groups.	Satisfactory

[a]Delay technique: all subjects were asked to quit smoking 1 day a week with gradual increase in smoke-free days per week.
[b]Scheduled smoking is a 3-week process wherein participants gradually reduce their nicotine intake to ease withdrawal symptoms after quitting.
[c]Employed computer software program that used six modules for specific processes of change.

Table 3. Individual-level interventions: smokeless tobacco use

Author/ year/ref	Institution/type of students/location	Study design/ intervention	Sample demographics	Outcome measures/ duration of follow-up	Findings	Rating
Darmody (1994)[19]	4-year Athletes in a private college New York	Two-part intervention for all athletes surveyed during initial assessment: oral exam by a dentist with feedback, individual counseling, educational presentation; and strict enforcement of policy against smokeless tobacco	Convenience sample; N=43 male varsity athletes recruited during practice on a specific day. 40% (n = 17) current users	Assessment of attitude, knowledge, and use of smokeless tobacoo by self-reported, pre- and post-intervention survey; response rate 79%. Post-survey after the first practice following the intervention (duration not specified)	Increased knowledge of the nicotine content in smokeless tobacco and its effect on certain aspects of health (increase from 4 to 7 students); no change in number of athletes who considered chew tobacco as a safe alternative to tobacco. Motivated some students (4 students) to contemplate quitting.	Not rated
Williams (1995)[27]	(Type of institution not specified) Athletes in 11 post secondary/ institutions in the mid-South Tennessee	Initial assessment of participants by standardized survey, randomly assigned to either 2 sessions (n =66) or 4 sessions (n=64); review of self-help quit manual[a] along with educational classes by trainers, coaches and faculty	Convenience sample; N=130 white males from 11 institutions who volunteered to participate; aged 18 to 27 years; recruited by advertisements, telephone contact with faculty and personnel, and in-class announcements by college personnel; n=110 completed intervention (15.4% dropout rate)	Self-reported abstinence and use of smokeless tobacco by personal and telephone interviews; and saliva cotinine to validate smoking status	Quit rate 14.5% (n=16) at 3 months; 41% decreased tobacco use at 3 weeks and 47% at 3 months; those who reported less snuff use/day quit more often than heavy users (p<0.01); no significant difference in quit rates between groups exposed to 2 sessions (10.6%) and 4 sessions (14.7%); quitters rated the manual more favorably than nonquitters.	Satisfactory
Walsh (1999)[28]	2- and 4-year Athletes in public universities and community colleges, 50% urban and 50% rural California	A case–control study where colleges were pair matched based on smokeless prevalence; with our college from each pair randomly assigned to usual care or usual care plus intervention. Intervention: brief oral exam along with feedback and brief individual counseling by a trained dental hygienist; distribution of self-help guide, and nicotine gum offered	Randomized sample of N=360 varsity baseball and football athletes from 16 colleges, recruited at a team meeting early in their athletic season; 23 subjects per college n=171 (intervention group) n=189 (no intervention group)	Self-reported abstinence and use of smokeless tobacco by pre-and post-intervention surveys, saliva collection in quitters using cotinine to validate smoking status. Follow-up by telephone contact at 1 and 3 months, up to a year	Following the intervention, prevalence of former smokers 35% at intervention colleges and 16% at control colleges, with intervention effect of 0.205 (p<0.08), adjusted for smokeless tobacco per week and brand. Effectiveness of intervention increased with the level in smokeless tobacco use.	Satisfactory

Table 3. Individual-level interventions: smokeless tobacco use *(continued)*

Author/ year/ref	Institution/type of students/location	Study design/ intervention	Sample demographics	Outcome measures/ duration of follow-up	Findings			Rating
						Intervention	Control	
					Quit within 3 months	23%	15%	
					Quit within 1 year	36%	16%	
					Quit by 3 months, and abstinent at year	13%	9%	

[a]Self-help quit manual developed by the American Cancer Society.

was improved in the intervention group as well, with 13% of those who quit at 3 months remaining abstinent at 1 year in the intervention group and 9% in the control group. Predictors of 1-year quit status were lower weekly consumption and use of chewing tobacco or snuff (other than Copenhagen or Skoal brands). In the Darmody et al.[19] study, which combined individual- and institutional-level interventions for athletes, quit rates were not reported. However, they did show slight improvements in the attitude toward quitting, and knowledge about health effects of smokeless tobacco use.

Institutional-Level Interventions: Tobacco Smoking

Of the four institutional-level studies, two were based in the United States,[18,33] and the other two were from Germany[29] and Switzerland[30] (Table 4). For the most part, these studies used convenience samples; three studies had relatively large sample sizes (>1000 students). One study by Chaloupka et al.[18] involved a secondary analysis of a multi-institutional study of binge drinking. The institutional-level interventions included smoking restrictions,[29] smoke-free policies,[30] and anti-tobacco messages.[33] In the study that assessed binge drinking, the impact of state- and local-level cigarette pricing and restrictions[18] was evaluated.

The main outcome measures were student perception,[29,30] approval of and compliance with institutional policies,[30,33] student participation in programs,[18] and cigarette consumption.[18] In most cases, self-administered surveys were used to assess outcomes. In two studies, smoking restrictions were acceptable to both smokers and nonsmokers.[29,30] Apel et al.[29] found that 28% of men and 30% of women surveyed were smoking fewer cigarettes 1 month after policy implementation. Etter and colleagues[30] found that quit attempts increased significantly (from 2% to 3.5%) in the intervention group while remaining constant at 3.8% in the control group. Hodges et al.[33] found that there was a 35% decrease in the number of cigarette butts collected in buildings 1 week after messages such as "Think. Why smoke?" were posted. The study did not use a comparison group and there was no additional follow-up.

Chaloupka et al.[18] examined the impact of two major tobacco policies—state- and local-level cigarette pricing, and restrictions on smoking by college students—in a multi-institutional nationwide U.S. study. Price of cigarettes and cigarette excise taxes were significantly related to all measures of smoking by college students, including reducing smoking and amount smoked (Table 4). Smoking restrictions in private and public places had lesser effects than those of pricing. The average overall estimated price elasticity of demand for cigarettes among college students of

Table 4. Institutional-level interventions: tobacco smoking

Author/year/ref	Type of institution/type of students/ location	Study design/intervention	Sample demographics	Outcome measures/ duration of follow-up	Findings	Rating
Apel (1997)[29]	4-year Undergraduates in a public university Germany	Diplomatic promotion of smoke-free policy indirectly by social marketing strategy; interview of students chosen by systematic central intercept (refusal rate <1%)	N=1223, 75% women and 25% men; 36% current smokers, 10% of men and 12% of women smoked >20 cigarettes per day	Assessment of student attitudes and perception by personal interviews; surveillance checks at designated areas of smoking 1 month after policy implementation	28% of men and 30% of women smoking less after policy implementation; high approval ratings by smokers and nonsmokers (91% of nonsmoking students and 68% of smokers supported the policy); one third of smokers complied voluntarily with policy during direct observation	Not rated
Etter (1999)[30]	4-year Students, residents, university staff, and employees at university Switzerland	Implementation of smoke-free policy by nonprofit local organization, buildings within university assigned to policy or no policy; intervention buildings received no smoking signs, posters, incentives, self-help manuals; smokers and nonsmokers were directly observed (17 sessions, 15 minutes each) in the smoking and nonsmoking areas for their interactions	Random sampling; n=2237 returned the first questionnaire (response rate 77%, N=2908); n=2184 returned the post-program survey (response rate 85%); analysis of 1856 surveys that had both pre- and post-survey information; n=833 (exposed); n=1023 (not exposed) Survey included both smokers and nonsmokers	Exposure to and being bothered by smoke; quality of relationship between smokers and nonsmokers, smoking status. Secondary variables: sales of cigarette packs in vending machines	At 4 months, quit attempts increased from 2% to 3.8% (p=0.04) for those who were exposed to the intervention, remained constant for those not exposed to the intervention at 3.5%, in the intervention-group, positive impact on acceptability (61% vs 64%), less bothered by environmental tobacco smoke (28% vs 14%) compared to control group. No impact on smoking prevalence of 25%.	Satisfactory
Hodges (1999)[33]	4-year Undergraduate students in a private university Pennsylvania	Removal of all cigarette butts in designated smoking areas[a] at public classroom buildings along with posting of anti-smoking messages near the doorway; cigarette butts also collected from a students residential hall with no antismoking messages for comparison	N=3 class buildings on campus	Cigarette butts collected before and after intervention. Counts of cigarette butts, length of cigarettes measured before and after intervention	35% reduction in whole cigarettes smoked outside the building during intervention week compared to the baseline. Number of butts collected on baseline days was significantly higher than the number of butts collected on sign days (p=.04); slight increase in number of whole cigarettes collected outside the residene hall.	Not rated

Table 4. Institutional-level interventions: tobacco smoking *(continued)*

Author/year/ref	Type of institution/type of students/ location	Study design/intervention	Sample demographics	Outcome measures-duration of follow-up	Findings	Rating
Chaloupka (1997)[18]	4-year Private and public colleges and universities Nationwide, U.S.	Self-administered survey data collected on daily cigarette consumption. State and local data on site specific cigarette prices and taxes and local restrictions on smoking in public places added to data by creating separate variables. Data analyzed by ordered methods and least squares methods	N=140 institutions, N=17,592 students from Harvard 1993 study on binge drinking, n=13,790 students after exclusion (individuals attending a college within 20 miles of a state with lower cigarette excise tax excluded)	Effects of state and local tobacco, pricing and smoking restrictions; smoking participation and consumption of cigarettes by students based on estimates from statistical models	Price of cigarettes and amount of cigarette excise taxes have significant negative impact on smoking by college students. 10% increase in price would reduce smoking participation by over 5% and consumption among smokers by 4.2% to 7.9%. Restrictions have effects, but less than pricing. Some restrictions on smoking can influence the decision to smoke among adults.	Not rated

[a]Ten-foot radius originating at the center of the main entrance to the buildings, where ashtray receptacles were located.

−1.11 was almost three times the consensus estimate of −0.4 for adults.[8]

Institutional-Level Interventions: Smokeless Tobacco Use

The only study[19] that explored the effectiveness of an institutional intervention to reduce smokeless tobacco use did so in combination with individual interventions (Table 5). Here, the policy against the use of smokeless tobacco by athletes was strictly enforced during the intervention. In a pre-intervention survey of 43 male varsity athletes, about half agreed that tobacco chewing should be allowed during practice, but only 12% agreed that the chewing should be allowed during games. A slight (nonsignificant) decrease in agreement with chewing during practice followed the intervention. No changes were noted in knowledge, attitudes, or use of smokeless tobacco. The number of athletes who complied with the policy during the intervention was not reported.

Discussion

The information in the published literature on programs/interventions that have targeted tobacco use in colleges and universities is limited. Only 14 studies published in the last 20 years were found, and the methods used varied widely. As a result, no firm conclusions could be reached regarding some of the interventions. Most studies on individual interventions reported lower cigarette or smokeless tobacco use among participants, but quit rates varied, and were typically based only on self-report with no biochemical validation. Most studies reported lower use of cigarettes or smokeless tobacco by students following an intervention,[18,19,29,33] but only two studies[29,30] reported on smoking prevalence after a smoke-free policy implementation. Evaluations of institutional interventions included changes in acceptability of and compliance with restrictions, but no changes in tobacco use behavior. Smoke-free policies and restrictions appear to be acceptable to both nonsmokers and smokers in general,[29,30,33] and many smokers voluntarily complied with the policies.[30]

Many limitations were noted in the studies reviewed. Only five of the studies reviewed met the criterion at the satisfactory level. Most did not use random sampling or random assignment to groups; in fact, many did not include comparison groups at all. Definitions of current tobacco use, quit status, and duration of abstinence were not clearly specified, and information on recruitment strategies and participation and response rates was lacking. With one exception,[27] interventions did not address dropout rates or indicate whether the "intention to treat" principle was used in the analyses. Even in the studies that used control groups, data on

Table 5. Institutional interventions: smokeless tobacco use

Author/year/ref	Type of institution/ type of students/ location	Study design/intervention	Sample demographics	Outcome measures/duration of follow-up	Findings	Rating
Darmody (1994)[19]	4-year Athletes in a private college New York	Two-part intervention for all athletes surveyed during initial assessment: oral exam by a dentist with feedback, individual counseling, educational presentation; and strict enforcement of policy against smokeless tobacco	Convenience sample; N=43 male varsity athletes recruited during a practice on a specific day 40% (n=17) current users	Assessment of attitude knowledge, and use of smokeless tobacco by self-reported, pre- and post-intervention survey; response rate 79%. Post-survey after the first practice following the intervention (duration not specified)	During the pre-test 49% (n=21) agreed that chewing should be allowed during practice, 12% agreed that chewing should be allowed during games; during post-test slight decrease in the number of students who agreed that chewing should be allowed during practice. Other findings: see Table 3.	Not rated

comparability at baseline were not provided. In addition, very few studies had follow-up results at 1 year.[22,28] Because of the lack of comparability between the studies, a systematic or aggregate analysis of the results could not be conducted. It certainly would be worthwhile in future studies to ensure greater specificity in definitions, more rigorous designs, clearly specified durations of follow-up, accounts of all participants, information on recruitment, measurement of exposure, and random sampling.

There are some issues that were not addressed in any of the studies. First, almost all of the studies took place at 4-year institutions. According to a nationwide survey,[4] the percentage of students who were current smokers and who tried unsuccessfully to quit was higher in 2-year (76.0%) than in 4-year (60.5%) institutions. Second, no information was found on the degree of involvement by college administrators; such data would be helpful in replicating the interventions. Third, no studies addressed specific subpopulation groups in college and universities, such as older students, racial/ethnic groups, disabled students, gay-lesbian-bisexual groups, or members of fraternities and sororities. Fourth, no studies evaluated the effectiveness of pharmacotherapies, either alone or in combination with counseling or other nonclinical interventions, for cessation of smoking. Finally, only one study[19] evaluated a comprehensive approach to reducing tobacco use among college athletes.

According to recent data, more than half of college smokers wish to quit.[35–39] And in a nationwide survey,[37] 85% of college health center directors and administrators perceived smoking as a problem on their campuses. Among these, 81% of colleges prohibited smoking in all public areas (e.g., public buildings, residence hall common areas, and residences, including student rooms and offices), and 56% offered some kind of cessation program for students, mainly in the form of support groups.

Colleges and universities can bring a wide range of resources to bear on the issue of tobacco use. Yet the effectiveness of the programs will depend on the appropriate use of available resources and their integration into other health education and promotion activities. Residence and academic advisors often develop ongoing relationships with students and their roles need to be explored. Healthcare providers in student health centers may offer a system change by using opportunities to counsel against tobacco use. In one survey, only 26% of students attending a campus health clinic remembered being asked about tobacco use by their healthcare providers,[40] and in another survey only 40% of smokers reported being given any advice to quit during college.[36] Because smokers are more likely than nonsmokers to visit student health centers,[41] the role of student health centers needs to be more fully examined. The potential roles of college staff members also

need to be studied, as they may be interested in assisting in interventions. In addition, the prevalence of smoking among faculty and administrative staff needs to be examined, as should the relationship to tobacco use levels among students. Interventions could be designed to include all groups on campus.

Most cessation interventions have been based on programs designed for adults.[42] Yet, the perception and attitudes of a college population and the factors that might motivate them to quit may differ from their older counterparts. Hellman et al.,[43] provided insight into the quitting process of college populations by stressing the need to utilize boyfriend/girlfriend influences to motivate smokers to quit. For an 18- to 22-year-old person, emphasis on the immediate impact on social relationships may be a bigger concern than a possible decrease in life expectancy.

In a comparison of college freshman smokers with nonsmokers, smokers rated "having friends and roommates who don't smoke" as most helpful for quitting.[44] Cold turkey was the preferred method of quitting,[35,36,43] and both interest and difficulty in quitting increased with increasing levels of addiction.[45] In two related studies, the strongest predictor of intention to participate in a program was a positive attitude, and participants showed greater interest in programs that required less time and effort.[46,47] Program acceptance has been found to depend on affordability and accessibility,[48] likelihood of success,[49] and self-efficacy.[50] Predictors of smoking among college students include lack of religious beliefs, binge drinking in high school, multiple sex partners, type of leisure time activities (e.g., nonparticipation in sports, endorsement of importance of parties), and dissatisfaction with education.[51] Interventions that address more than one behavior or that deal with the underlying constructs (stress, coping) might prove to be effective,[52] as well as increase perception of health risk.[51,53,54]

No single intervention can appeal to everyone, and students might appreciate a multifaceted approach with policies restricting smoking in dormitories, smoke-free campuses, prohibitions on the sale and marketing of tobacco products on campuses, and restrictions on tobacco industry support of events on campus.[55] In this context, multicomponent interventions that combine mass media campaigns with other efforts to increase cessation may be effective.[56,57] These include promotional campaigns,[46,58] peer group support, emphasis on positive outcomes of cessation,[47] and social marketing.[49] Accessibility can be increased by flexible, low-demand "satellite" programs, or programs at strategic places.[50] Counteradvertising in campus publications with high readership (university newspapers) and in locations where tobacco is purchased (grocery stores and gas stations) may be useful.[48] Given that young adults are relatively more responsive to price than older smokers, increases in the cost of cigarettes (through taxation and other means) may be effective in reducing cigarette smoking among them.[18,42,57] Evaluation and dissemination of comprehensive approaches such as these are essential.

Limitations of the studies reviewed notwithstanding, overall their outcomes are encouraging. The results indicate a positive impact on student attitudes and knowledge of tobacco use, increased awareness, and motivation to quit smoking. Both smokers and nonsmokers appear to accept and comply with smoke-free policies on campus.[29,30]

What This Study Adds . . .

The level of tobacco use among young adults has become a recent concern.

While there are few rigorous evaluations, published interventions indicate that interventions can have a positive influence on college student behavior.

Specifically, interventions may reduce tobacco use among college students, and increase acceptability of smoking policies and campus restrictions among both tobacco users and non-users.

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